

At these points, change "medium" to --ocean-volume--  
(note the hyphen): claim 41, at line 7;  
claim 48, at lines 4 and 7;  
claim 49, at line 8;  
claim 50, at lines 3 and 5;  
claim 66, at line 14; and  
claim 72, at line 6.

Please change claims 33, 36, 38, 40, 64 and 67, and add  
new claims 73 through 98, all to read as indicated below.

(For the Examiner's convenience the new claims have been  
inserted in the claim sequence at these points where they are  
desired:

claims 73 through 83 following claim 33;  
claims 84 through 88 following claim 38;  
claims 89 through 92 following claim 56;  
claim 93 following claim 67; and  
claims 94 through 98 following claim 72.)

SUBJECT

1 33. (amended) An imaging system for forming an image of a  
2 thin section of a turbid medium, namely a thin section of ocean  
3 volume, with objects therein, said system comprising:  
4 means for projecting a pulsed thin-fan-shaped beam to  
5 selectively illuminate, along an illumination-propagation  
6 direction, a thin section of such turbid ocean volume [medium];  
7 a streak tube, having a cathode for receiving reflected  
8 light back, approximately along the illumination-propagation

9 direction, from the thin section of turbid ocean volume  
10 [medium]; said streak tube also having an anode end, and  
11 comprising:

12  
13 first electronic means for forming at the anode end  
14 of the streak tube successive thin-strip-shaped electron-  
15 ic-image segments of the light successively received on  
16 the cathode from the illuminated turbid-ocean-volume  
17 [medium] thin section, and

18  
19 second electronic means for distributing the succes-  
20 sive thin-strip-shaped electronic-image segments, along a  
21 direction generally perpendicular to a long dimension of  
22 the image segments, across the anode end of the streak  
23 tube,

24  
25 said distributing of the electronic-image segments  
26 being in accordance with elapsed time after operation of  
27 the beam-projecting means so that each thin-strip-shaped  
28 electronic-image segment is displaced from a side of the  
29 anode end of the tube substantially in proportion to total  
30 propagation distance and time into and out from the  
31 turbid-medium thin section, to form a composite electronic  
32 image of the turbid-ocean-volume [medium] thin section as  
33 a function of propagation depth.

1 73. (to follow claim 33) The system of claim 33, further  
2 comprising:

3 means for imposing a substantially common spatial defini-  
4 tion and directional restriction, in one dimension, upon (1)  
5 the pulsed thin-fan-shaped beam projected by the projecting  
6 means and (2) the reflected light received back from the thin  
7 section of turbid ocean volume.

B2  
cont  
C 1 8.  
74 (to follow claim 73) The system of claim <sup>5</sup>~~33~~<sub>73</sub> wherein the  
2 common-restriction-imposing means comprise:

3 means for constraining, in said one dimension, the field  
4 from which said reflected light can reach said streak-tube  
5 cathode; and

6 means for aligning, with respect to said one dimension,  
7 the field-constraining means with the thin-fan-shaped beam.

9.  
1 ~~75.~~ (to follow claim 74) The system of claim <sup>8</sup>~~74~~, wherein:  
2 the field-constraining means comprise an optical slit that  
3 is narrow in said one dimension; and  
4 the aligning means comprise means for aligning, with  
5 respect to said one dimension, the slit with the thin-fan-  
6 shaped beam.

10.  
1 ~~76~~ (to follow claim 75) The system of claim ~~75~~<sup>9</sup>, wherein the  
2 common-restriction-imposing means further comprise:  
3 means for limiting, with respect to said one dimension,  
4 the field illuminated by the thin-fan-shaped beam.

11.  
1 ~~77~~ (to follow claim 76) The system of claim ~~76~~<sup>10</sup>, wherein:  
2 the beam-field-limiting means comprise an anamorphic  
3 optical element for asymmetrically expanding a laser beam with  
4 cross-section on the order of a centimeter to strike an area on  
5 the ocean surface of a few meters by more than one thousand  
6 meters.

SUP 22

copy

1 78. (to follow claim 77) The system of claim 33, further  
2 comprising:  
3 means for bodily displacing the beam-projecting means and  
4 streak tube together, along a direction generally perpendicular  
5 to a long dimension of the thin section of turbid ocean volume,  
6 while sequentially operating the beam-projecting means to  
7 project a sequence of beam pulses to illuminate successive thin  
8 sections, and generate a corresponding sequence of composite  
9 electronic images;  
10 means for processing the composite electronic images to  
11 produce a corresponding sequence of composite optical images,  
12 and for visually displaying the sequence of composite optical  
13 images to show a motion picture that emulates visual percep-  
14 tions of travel through the successive thin sections of turbid  
15 ocean volume.

13.  
79. (to follow claim 78) The system of claim <sup>12</sup>78, wherein:  
the bodily-displacing means comprise an aircraft support-  
ing the beam-projecting means and streak tube together and  
flying above the ocean along said direction generally perpen-  
dicular to a long dimension of the thin section of turbid ocean  
volume;

7 said beam-projecting means project said sequence of beam  
8 pulses downward from said aircraft, through air above the  
9 turbid ocean volume, and then downward into the turbid ocean  
10 volume; and

11 said reflected light received back from the thin section  
12 of turbid ocean volume passes upward from the turbid ocean  
13 volume, through air above the turbid ocean volume, to said  
14 aircraft.

14.  
80. (to follow claim 79) The system of claim <sup>13</sup>79, wherein:

2 a centerline of every beam pulse is substantially in a  
3 plane defined by (1) said direction of flight and (2) <sup>a</sup>vertical <sup>line</sup>;  
4 and

5 a centerline of said reflected light received back from  
6 the thin section of turbid ocean volume is substantially in the  
7 same plane.

15,  
~~81~~

13  
~~79~~

(to follow claim 80) The system of claim wherein:

said beam-projecting means effectively illuminate such objects in the thin section of turbid ocean volume;

said beam-projecting means do not effectively illuminate portions of the thin section of turbid ocean volume immediately below such objects;

said cathode effectively receives said reflected light back from such illuminated objects;

said cathode does not effectively receive reflected light back from the thin section of turbid ocean volume immediately below such objects;

said composite electronic images and composite optical images include images of such illuminated objects, and of the turbidity in the thin section of turbid ocean volume, arising from said effectively received reflected light; and

said composite-optical-image motion picture includes shadow images below such illuminated objects, arising from absence of effectively received reflected light from said thin section of turbid ocean volume immediately below such illuminated objects.

16.

12

1 ~~82~~ (to follow claim 81) The system of claim ~~78~~, wherein:

2 said beam-projecting means effectively illuminate such  
3 objects in the thin section of turbid ocean volume;

4 said beam-projecting means do not effectively illuminate  
5 portions of the thin section of turbid ocean volume immediately  
6 behind such objects;

7 said cathode effectively receives said reflected light  
8 back from such illuminated objects;

9 said cathode does not effectively receive reflected light  
10 back from the thin section of turbid ocean volume immediately  
11 behind such objects;

12 said composite-optical-image motion picture includes  
13 images of such illuminated objects, and of the turbidity in the  
14 thin section of turbid ocean volume, arising from said effec-  
15 tively received reflected light; and

16 said composite-optical-image motion picture includes  
17 shadow images behind such illuminated objects, arising from  
18 absence of effectively received reflected light from said thin  
19 section of turbid ocean volume immediately behind such illumi-  
20 nated objects.



SUB 3

Depend

1 83. (to follow claim 82) The system of claim 33, wherein:  
2 said beam-projecting means effectively illuminate such  
3 objects in the thin section of turbid ocean volume;  
4 said beam-projecting means do not effectively illuminate  
5 portions of the thin section of turbid ocean volume immediately  
6 behind such objects;  
7 said cathode effectively receives said reflected light  
8 back from such illuminated objects;  
9 said cathode does not effectively receive reflected light  
10 back from the thin section of turbid ocean volume immediately  
11 behind such objects;  
12 said composite electronic image includes images of such  
13 illuminated objects, and of the turbidity in the thin section  
14 of turbid ocean volume, arising from said effectively received  
15 reflected light; and  
16 said composite electronic image includes shadow images  
17 behind such illuminated objects, arising from absence of  
18 effectively received reflected light from said thin section  
19 of turbid ocean volume immediately behind such illuminated  
20 objects.

SUBC4

1 36. (amended) An imaging system for forming an image of a  
2 thin section of a turbid medium, namely a thin section of ocean  
3 volume, with objects therein, said system comprising:

4 means for projecting a pulsed thin-fan-shaped beam to  
5 selectively illuminate, along an illumination-propagation  
6 direction, a thin section of such turbid ocean volume [medium];  
7 said beam penetrating and propagating within the thin section  
8 during a first range of times corresponding to beam propagation  
9 depth into the thin section;

B3  
cont  
10 a streak tube, having a cathode for receiving reflected  
11 light back, approximately along the illumination-propagation  
12 direction, from the thin section of turbid ocean volume [me-  
13 dium] during a second range of times corresponding to total  
14 propagation distances into and out from the thin section  
15 approximately along the illumination-propagation direction;  
16 said streak tube also having an anode end, and comprising:

17  
18 first electronic means for forming at the anode end  
19 of the streak tube successive thin-strip-shaped electron-  
20 ic-image segments of the light successively received on  
21 the cathode from the illuminated turbid-ocean-volume  
22 [medium] thin section, at particular times corresponding  
23 to the particular total propagation distances for particu-  
24 lar penetration depths, and

25  
26 second electronic means for distributing the succes-  
27 sive thin-strip-shaped electronic image segments, along a

28 direction generally perpendicular to a long dimension of  
29 the images, across the anode end of the streak tube in  
30 accordance with said second range of times corresponding  
31 to total propagation distances into and out from the thin  
32 section of turbid ocean volume [medium], to form a compos-  
33 ite electronic image of the turbid-ocean-volume [medium]  
34 thin section as a function of propagation depth.

---

SUBC5

1 38. (amended) The system of claim 37, further comprising:  
2 means for bodily displacing the beam-projecting means and  
3 streak tube together, along a direction generally perpendicular  
4 to a long dimension of the thin section of turbid ocean volume  
5 [medium], while sequentially operating the beam-projecting  
6 means to project a sequence of beam pulses to illuminate  
7 successive thin sections, and generate a corresponding sequence  
8 of composite electronic images; and  
9 means for processing the composite electronic images to  
10 produce a corresponding sequence of composite optical images,  
11 [;] and [means] for visually displaying the sequence of said  
12 composite optical images to show a motion picture that emulates  
13 visual perceptions of travel through the successive thin  
14 sections of turbid ocean volume [medium].

---

1 <sup>21</sup>/~~84~~ (to follow claim 38) The system of claim <sup>20</sup>/~~38~~, wherein:  
2 the bodily-displacing means comprise an aircraft support-  
3 ing the beam-projecting means and streak tube together and  
4 flying above the ocean along said direction generally perpen-  
5 dicular to a long dimension of the thin section of turbid ocean  
6 volume;

7 said beam-projecting means project said sequence of beam  
8 pulses downward from said aircraft, through air above the  
9 turbid ocean volume, and then downward into the turbid ocean  
10 volume; and

11 said reflected light received back from the thin section  
12 of ocean volume passes upward from the ocean volume, through  
13 air above the ocean volume, to said aircraft.

1 <sup>22</sup>/~~85~~ (to follow claim 84) The system of claim <sup>21</sup>/~~84~~, wherein:

2 a centerline of every beam pulse is substantially in a  
3 plane defined by (1) said direction of flight and (2) <sup>a</sup> vertical <sup>line</sup>;  
4 and

5 a centerline of said reflected light received back from  
6 the thin section of turbid medium is substantially in the same  
7 plane.

<sup>23/</sup>  
~~86~~

<sup>2/</sup>  
~~84~~

(to follow claim 85) The system of claim ~~84~~, wherein:

said beam-projecting means effectively illuminate such objects in the thin section of turbid ocean volume;

said beam-projecting means do not effectively illuminate portions of the thin section of turbid ocean volume immediately below such objects;

said cathode effectively receives said reflected light back from such illuminated objects;

said cathode does not effectively receive reflected light back from the thin section of turbid ocean volume immediately below such objects;

said composite electronic images and composite optical images include images of such illuminated objects, and of the turbidity in the thin section of turbid ocean volume, arising from said effectively received reflected light; and

said composite-optical-image motion picture includes shadow images below such illuminated objects, arising from absence of effectively received reflected light from said thin section of turbid ocean volume immediately below such illuminated objects.

copy

24.  
87.

38, wherein:

1 (to follow claim 86) The system of claim 38, wherein:  
2 said beam-projecting means effectively illuminate such  
3 objects in the thin section of turbid ocean volume;

4 said beam-projecting means do not effectively illuminate  
5 portions of the thin section of turbid ocean volume immediately  
6 behind such objects;

7 said cathode effectively receives said reflected light  
8 back from such illuminated objects;

9 said cathode does not effectively receive reflected light  
10 back from the thin section of turbid ocean volume immediately  
11 behind such objects;

12 said composite-optical-image motion picture includes  
13 images of such illuminated objects, and of the turbidity in the  
14 thin section of turbid ocean volume, arising from said effec-  
15 tively received reflected light; and

16 said composite-optical-image motion picture includes  
17 shadow images behind such illuminated objects, arising from  
18 absence of effectively received reflected light from said thin  
19 section of turbid ocean volume immediately behind such illumi-  
20 nated objects.

SUBC 6

1 88. (to follow claim 87) The system of claim 36, wherein:

2 said beam-projecting means effectively illuminate such  
3 objects in the thin section of turbid ocean volume;

4 said beam-projecting means do not effectively illuminate  
5 portions of the thin section of turbid ocean volume immediately  
6 behind such objects;

7 said cathode effectively receives said reflected light  
8 back from such illuminated objects;

9 said cathode does not effectively receive reflected light  
10 back from the thin section of turbid ocean volume immediately  
11 behind such objects;

12 said composite electronic image includes images of such  
13 illuminated objects, and of the turbidity in the thin section  
14 of turbid ocean volume, arising from said effectively received  
15 reflected light; and

16 said composite electronic image includes shadow images  
17 behind such illuminated objects, arising from absence of  
18 effectively received reflected light from said thin section  
19 of turbid ocean volume immediately behind such illuminated  
20 objects.

1 <sup>25.</sup>~~40.~~ (amended) The system of claim <sup>18</sup>~~39~~ further comprising:  
2 means for roughly compensating for geometrical effects  
3 such as increased path length to beam-pattern ends, or cosine  
4 losses on illumination and on return, that systematically vary  
5 the intensity of reflected light, along the long dimension of  
6 the thin section of turbid ocean volume [medium].

1 89. (to follow claim 56) The system of claim 56, wherein:  
2 the bodily-displacing means comprise an aircraft support-  
3 ing the beam-projecting means and streak tube together and  
4 flying above the turbid ocean volume along said direction  
5 generally perpendicular to a long dimension of the thin section  
6 of turbid ocean volume;

7 said beam-projecting means project said sequence of beam  
8 pulses downward from said aircraft, through air above the  
9 turbid ocean volume, and then downward into the turbid ocean  
10 volume; and

11 said reflected light received back from the thin section  
12 of turbid ocean volume passes upward from the turbid ocean  
13 volume, through air above the turbid ocean volume, to said  
14 aircraft.



1 <sup>33</sup>~~90~~ (to follow claim 89) The system of claim <sup>32</sup>~~89~~, wherein:

2 a centerline of every beam pulse is substantially in a

3 plane defined by (1) said direction of flight and (2) <sup>a</sup>vertical <sup>line</sup>;

4 and

5 a centerline of said reflected light received back from

6 the thin section of turbid ocean volume is substantially in the

7 same plane.

34  
91

32  
89

(to follow claim 90) The system of claim 89, wherein:

said beam-projecting means effectively illuminate such objects in the thin section of turbid ocean volume;

said beam-projecting means do not effectively illuminate portions of the thin section of turbid ocean volume immediately below such objects;

said cathode effectively receives said reflected light back from such illuminated objects;

said cathode does not effectively receive reflected light back from the thin section of turbid ocean volume immediately below such objects;

said video sequence, displayed by the electronic-image-sequence using means, includes visible images of:

such illuminated objects, and of the turbidity in the thin section of turbid ocean volume, arising from said effectively received reflected light, and

shadows below such illuminated objects, arising from absence of effectively received reflected light from said thin section of turbid ocean volume immediately below such illuminated objects.

B7  
conf

35.  
92.

3/  
56.

1 (to follow claim 91) The system of claim 56, wherein:

2 said beam-projecting means effectively illuminate such  
3 objects in the thin section of turbid ocean volume;

4 said beam-projecting means do not effectively illuminate  
5 portions of the thin section of turbid ocean volume immediately  
6 behind such objects;

7 said cathode effectively receives said reflected light  
8 back from such illuminated objects;

9 said cathode does not effectively receive reflected light  
10 back from the thin section of turbid ocean volume immediately  
11 behind such objects;

12 said video sequence, displayed by the electronic-image-  
13 sequence using means, includes visible images of:

14

15 such illuminated objects, and of the turbidity in the  
16 thin section of turbid ocean volume, arising from said  
17 effectively received reflected light, and

18

19 shadows behind such illuminated objects, arising from  
20 absence of effectively received reflected light from said  
21 thin section of turbid ocean volume immediately behind  
22 such illuminated objects.

8029  
1 64. (amended) An imaging system for forming an image of a  
2 thin section of a turbid medium, namely a thin section of ocean  
3 volume, with objects therein, said system comprising:

4 means for projecting a pulsed thin-fan-shaped beam to  
5 selectively illuminate a thin section of such turbid ocean  
6 volume [medium];

7 a streak-tube cathode for receiving reflected light back,  
8 approximately along the illumination-propagation direction,  
9 from the thin section of turbid ocean volume [medium];

10 means for focusing the reflected light onto the streak-  
11 tube cathode substantially directly;

12 said focusing means comprising:

802  
cont  
13  
14 (1) no "glass plate stack" image slicer for optically  
15 mapping portions of said reflected light onto portions of  
16 a light-receiving surface, and

17  
18 (2) no other type of image slicer for optically  
19 mapping portions of said reflected light onto portions of  
20 a light-receiving surface, and

21  
22 (3) no pixel-encoding fiber bundle for optically  
23 mapping a two-dimensional reflected image into a line  
24 image, and

25  
26 (4) no other pixel-encoding fiber bundle for optical  
27 mapping of a reflected image, and

28 (5) [(3)] no other optical image-mapping [-remapping]  
29 device other than basic optical elements such as a lens or  
30 mirror; and

31  
32 streak-tube means, responsive to the focused reflected  
33 light, for forming therefrom a corresponding composite elec-  
34 tronic image of the turbid-ocean-volume [medium] thin section  
35 as a function of propagation depth.

---

SUBC 11

67. A method of imaging a turbid medium, namely a thin section of ocean volume, with objects therein, said method comprising the steps of:

projecting a pulsed thin-fan-shaped beam to selectively illuminate, along an illumination-propagation direction, a thin section of such turbid ocean volume [medium];

then at a substantially common location with the projecting step, receiving reflected light back, approximately along the illumination-propagation direction, from the thin section of turbid ocean volume [medium];

forming successive thin-strip-shaped image segments which are respectively images of the reflected light successively received along approximately the illumination-propagation direction;

distributing the successive thin-strip-shaped image segments, along a direction generally perpendicular to a long dimension of the images;

said distributing of the image segments being in accordance with elapsed time after the beam-projecting step so that each thin-strip-shaped image segment is displaced from a common baseline position substantially in proportion to total propagation distance and time into and out from the turbid ocean volume [medium], to form a composite image of the turbid-ocean-volume [medium] thin section as a function of propagation depth;

[after the projecting and receiving steps,] shifting said common location in a direction roughly [substantially] at right

28 angles to both (1) a long dimension of the thin-fan-shaped beam  
29 and (2) the illumination-propagation direction;  
30 repeating all of the above steps multiple times [, with at  
31 least the projecting, receiving and shifting steps in the  
32 indicated order,] to form multiple composite images of progres-  
33 sively encountered turbid-ocean-volume [medium] thin sections  
34 as a function of propagation depth.

47.  
1 ~~93~~ (to follow claim 67) The method of claim ~~67~~<sup>47</sup>, wherein:  
2 said common-location-shifting step is after the projecting  
3 and receiving steps; and  
4 at least the projecting, receiving and shifting steps are  
5 in that order.

810  
902  
1 94. An imaging system for forming an image of a thin sec-  
2 tion of a turbid medium with objects therein, said system  
3 comprising:  
4 means for projecting a pulsed thin-fan-shaped beam to  
5 selectively illuminate, along an illumination-propagation  
6 direction, a thin section of such turbid medium;  
7 a streak tube, having a cathode for receiving reflected  
8 light back, approximately along the illumination-propagation  
9 direction, from the thin section of turbid medium; said streak  
10 tube also having an anode end, and comprising:  
11

12 first electronic means for forming at the anode end  
13 of the streak tube successive thin-strip-shaped electron-  
14 ic-image segments of the light successively received on  
15 the cathode from the illuminated turbid-medium thin sec-  
16 tion, and

17  
18 second electronic means for distributing the succes-  
19 sive thin-strip-shaped electronic-image segments, along a  
20 direction generally perpendicular to a long dimension of  
21 the image segments, across the anode end of the streak  
22 tube,

23  
24 said distributing of the electronic-image segments  
25 being in accordance with elapsed time after operation of  
26 the beam-projecting means so that each thin-strip-shaped  
27 electronic-image segment is displaced from a side of the  
28 anode end of the tube substantially in proportion to total  
29 propagation distance and time into and out from the  
30 turbid-medium thin section, to form a composite electronic  
31 image of the turbid-medium thin section as a function of  
32 propagation depth; and

33  
34 means for imposing a substantially common spatial defini-  
35 tion and directional restriction, in one dimension, upon (1)  
36 the pulsed thin-fan-shaped beam projected by the projecting  
37 means and (2) the reflected light received back from the thin  
38 section of turbid medium.



1 95. The system of claim 94, wherein the common-restriction-  
2 imposing means comprise:

3 means for constraining, in one dimension, the field from  
4 which said reflected light can reach said streak-tube cathode;  
5 and

6 means for aligning the field-constraining means, with  
7 respect to said one dimension, with the thin-fan-shaped beam.

1 96. The system of claim 95, wherein:

2 the field-constraining means comprise an optical slit that  
3 is thin in said one dimension; and

4 the aligning means comprise means for aligning the slit,  
5 with respect to said one dimension, with the thin-fan-shaped  
6 beam.

1 97. The system of claim 96, wherein the common-restriction-  
2 imposing means further comprise:

3 means for limiting, in said one dimension, the field  
4 illuminated by the thin-fan-shaped beam.